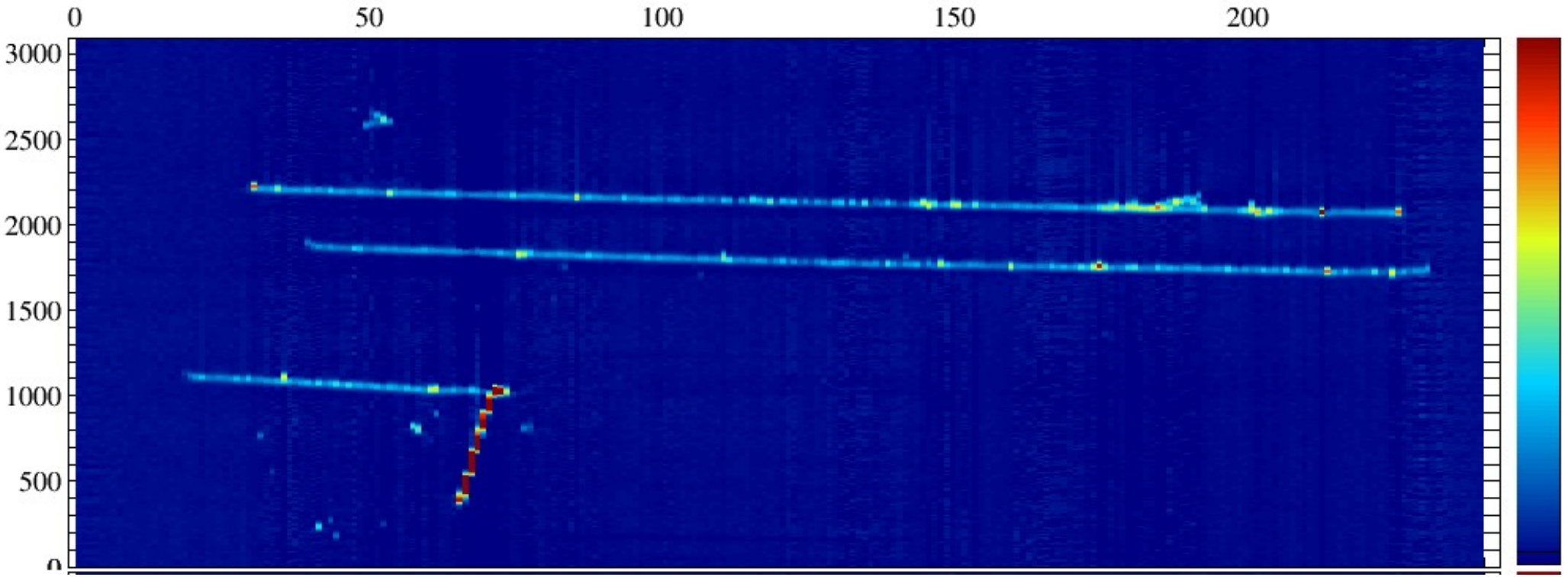
Charged Pion Summary



Jonathan Asaadi

Updates

- **Updates to the Analysis**
  - Spent some time debugging problems in the analysis and comparing to the previous results
  - Also followed up on suggestions from the last discussion (many thanks to those who gave suggestions)
- **Adding in some more Monte Carlo estimates**

Run Number	Slicer	BEAMON No Pileup	Beamline Reco	TPC Reco
6110	2,798	533 (19.1%)	533	533
6112	4,715	1566 (33.2%)	948 *(error processing)*	948
6113	2,036	699 (34.3%)	699	699
6116	24,057	3,269 (13.6%)	3,269	3,269
6260	8,442	164 (1.9%)	164	164
6261	15,998	337 (2.1%)	273 *(error processing)*	273
6262	12,578	256 (2.0%)	256	256
6263	41,709	778 (1.9%)	778	778
6307	4,677	472 (10.1%)	472	472
6308	16,046	2,875 (17.9%)	2,875	2,875
6310	1,583	269 (17.0%)	269	269
6311	9,575	1,468 (15.3%)	1,468	1,468
6312	3,325	504 (15.1%)	504	504
6313	3,234	466 (14.4%)	466	466
6323	22,556	2,623 (11.6%)	2,623	2,623
6324	7,152	603 (8.4%)	603	603
6326	31,705	4,315 (13.6%)	4,315	4,315
Total	212,176	21,197 (10%)	20,515 (96.7%)	20,515 (100%)

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Total	212,176	21,197 (10%)	20,515 (96.7%)	20,515 (100%)

No change when removing the "No Pileup" veto from the filter

Event Reduction Table

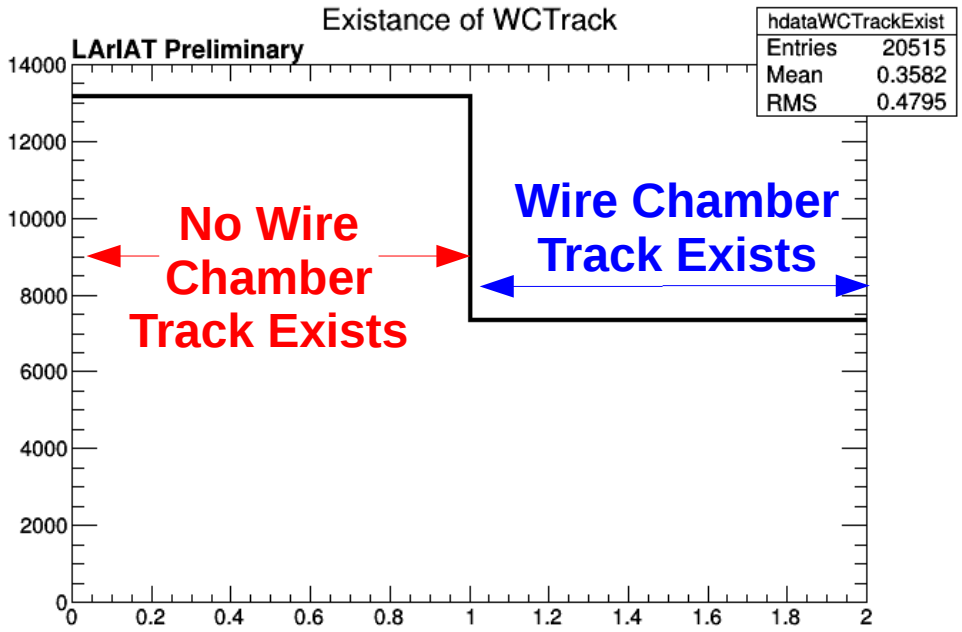
Analysis Cut	# of Events passing this cut (20,515)
Require a Wire Chamber Track	7,348 (35.8%)
Require a track w/ a SpacePoint in the first 2 cm of the TPC	6,706 (91.3%)
Require one and only one match between WCTrack and TPC Track *-2 cm < ΔX < 6 cm , -3 cm < ΔY < 6 cm*	3,801 (56.7%)
Require < 4 TPC tracks in the first 14 cm of the TPC	2,573 (67.7%)
Angle between WC and TPC Track ($\alpha < 20^o$)	2,368 (92.0%)

Using PionXSection Module

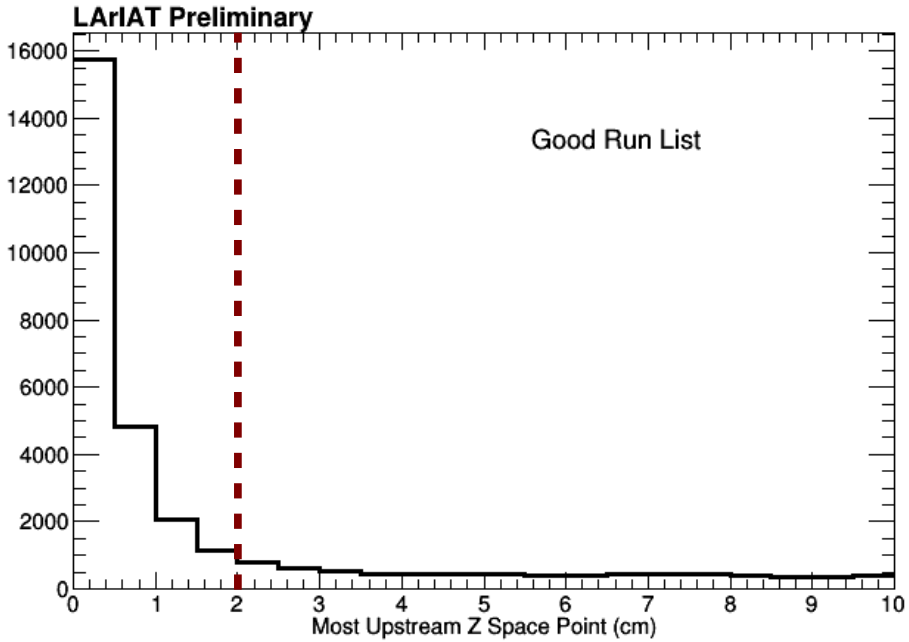
Analysis Cut	# of Events passing this cut (20,515)
Require a Wire Chamber Track	##### ()
Require a track w/ a SpacePoint in the first 2 cm of the TPC	
Require only one match between WCTrack and TPC Track *-2 cm < ΔX < 6 cm , -3 cm < ΔY < 6 cm*	
Require < 4 TPC tracks in the first 14 cm of the TPC	()
Angle between WC and TPC Track ($\alpha < 20^{o}$)	##### ()

In the process of cross-checking and generating results

Plots of the cuts



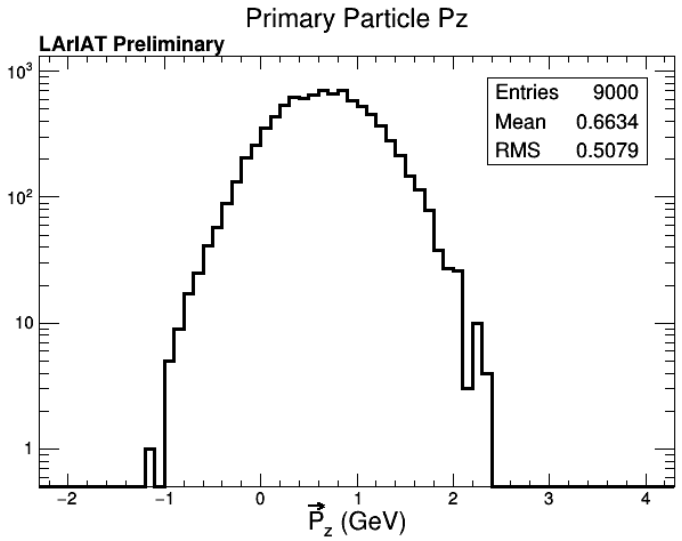
- **We would love to see the WCTrack improvements**
  - We know Greg and Jason and Randy are working really hard on this and eagerly await....

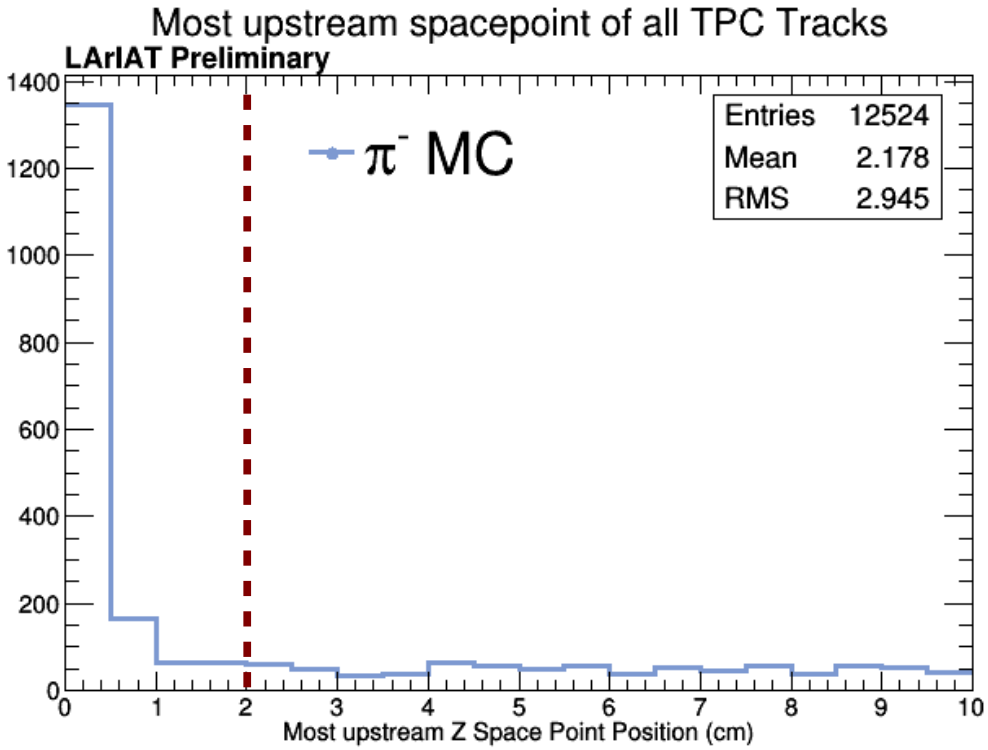


- **Currently we require a track to have its first spacepoint w/ z position in the first 2 cm of the TPC**
  - Moving this cut to 3 cm brings back ~900 events
  - Each cm after that accounts for ~600 events
    - ***Looking to MC to tell us where this cut should be placed....***

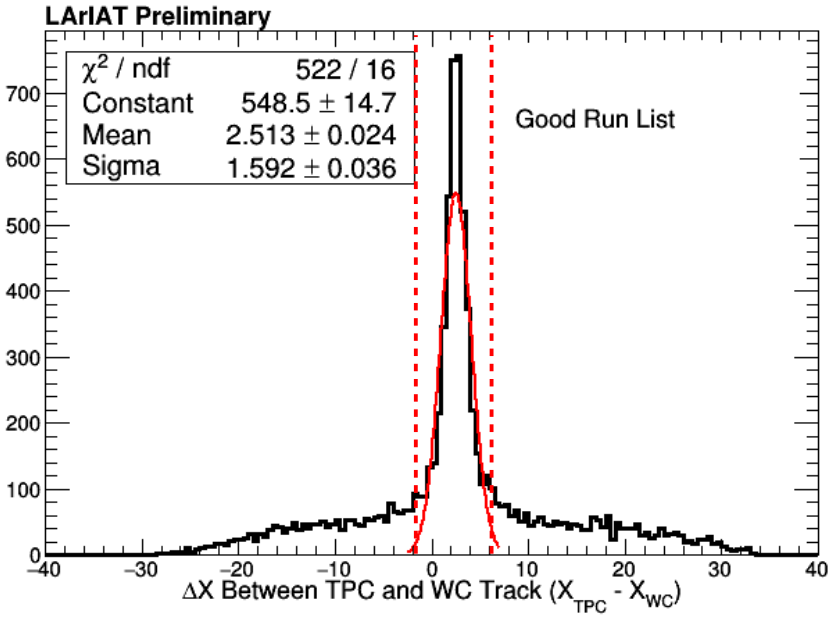
What does MC tell us?

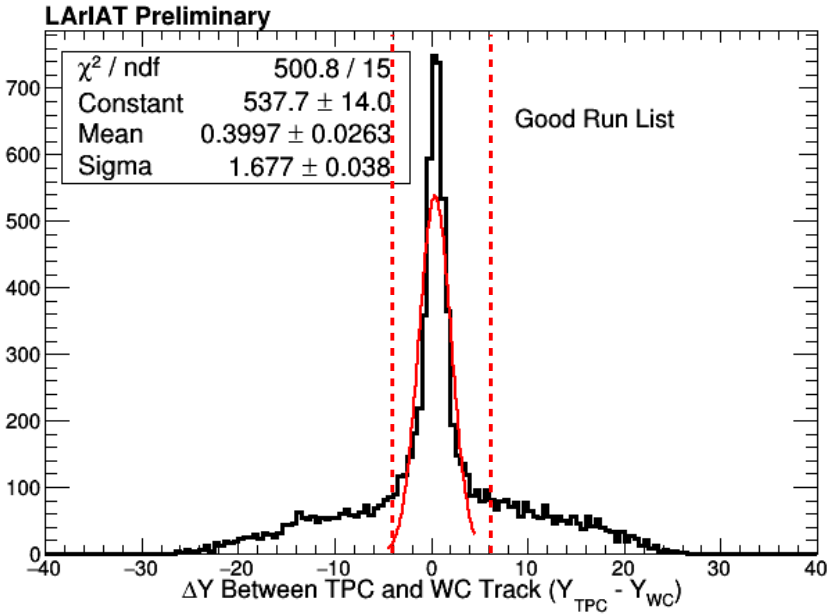
- **Using 9000 π^- launched from z position = -8 cm with the momentum spectrum shown we can analyze what the hit distribution look like**



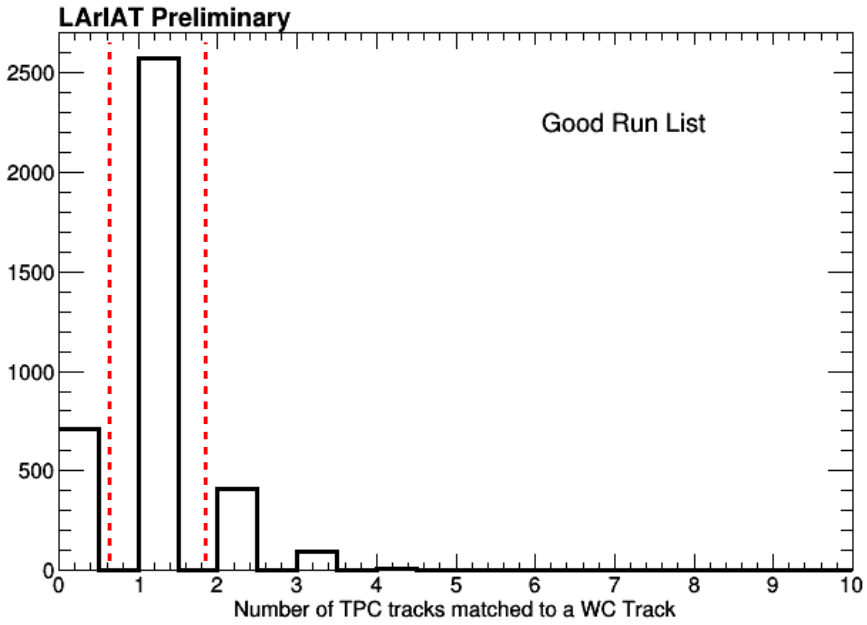


Plots of the cuts

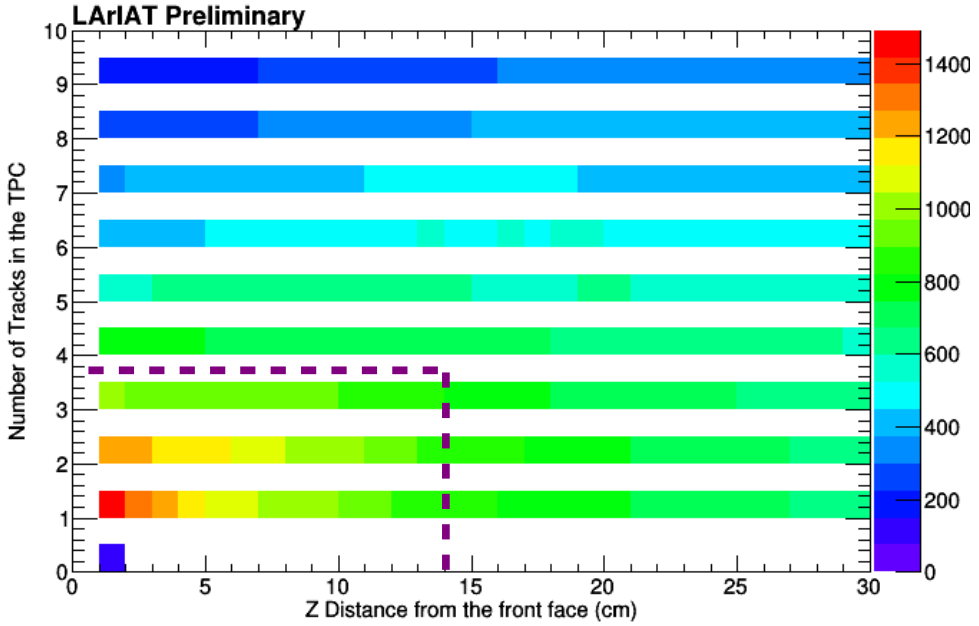


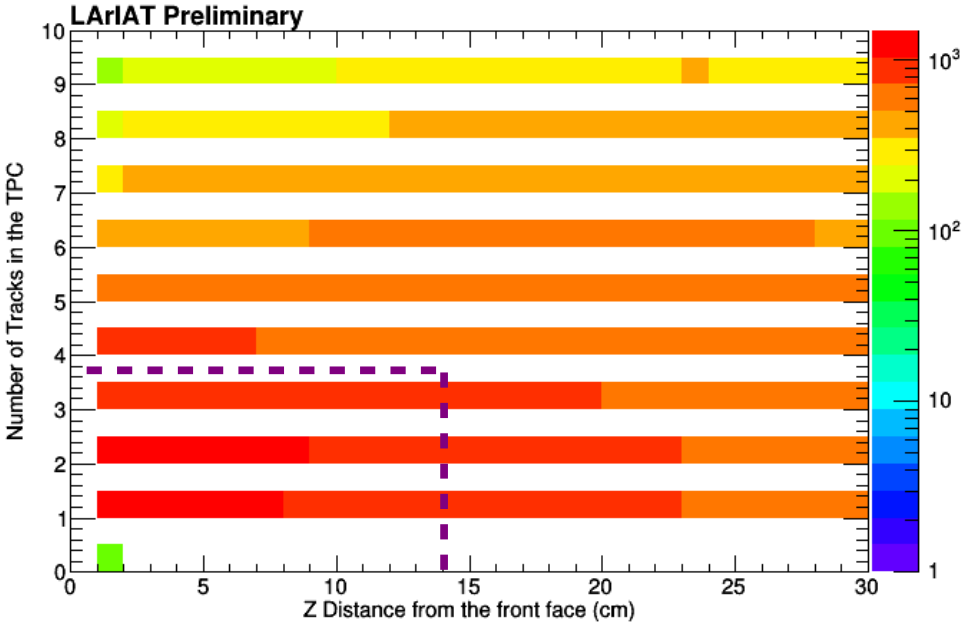


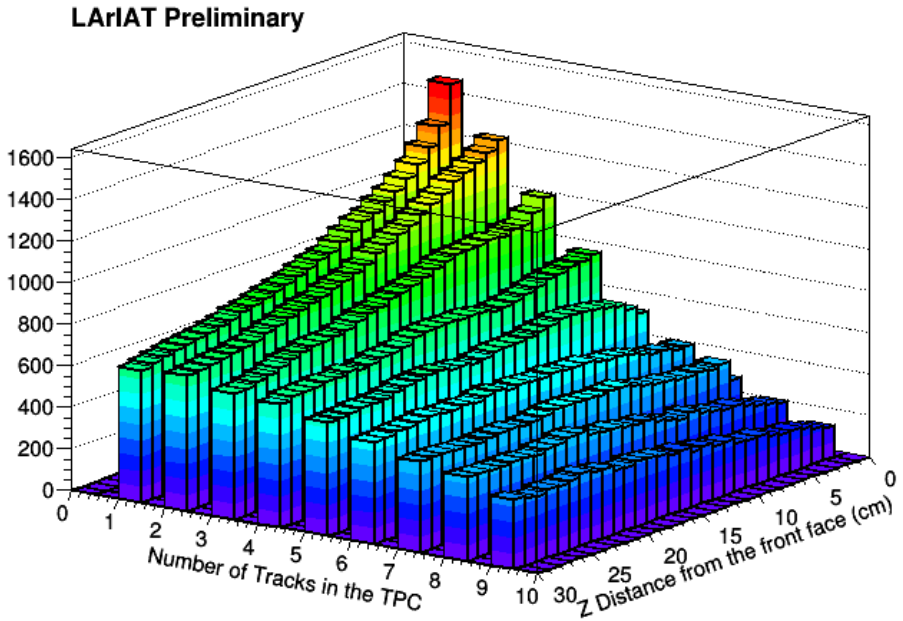
- **Require one and only one TPC track which matches to a WC Track**
  - Delta X seems to have a shift of ~2.5 cm
  - Delta Y seems symmetric about 0 cm
    - Could consider making this matching cut symmetric about Y=0



Plots of the cuts

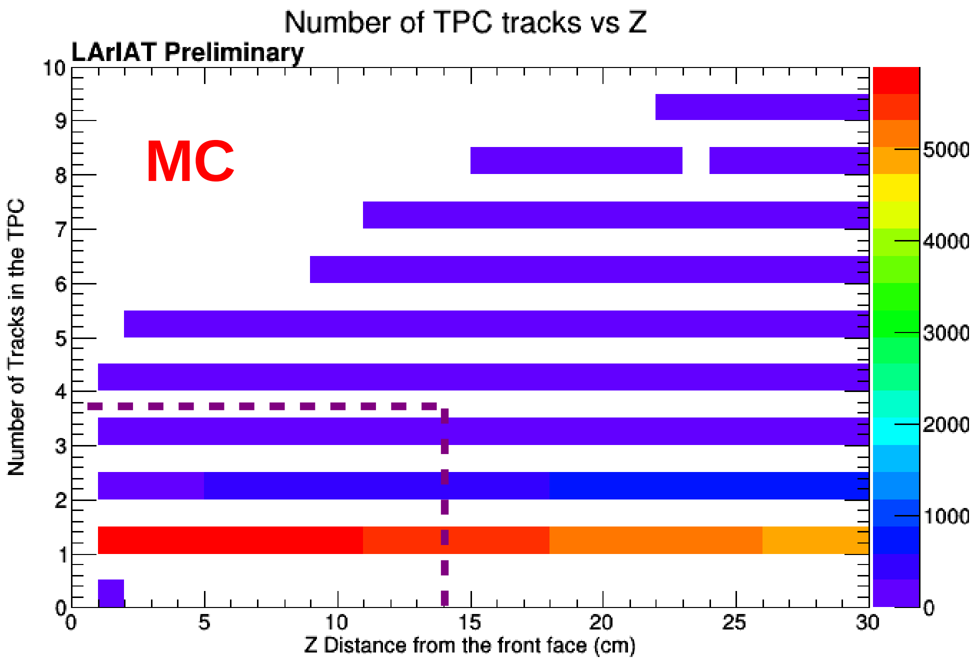


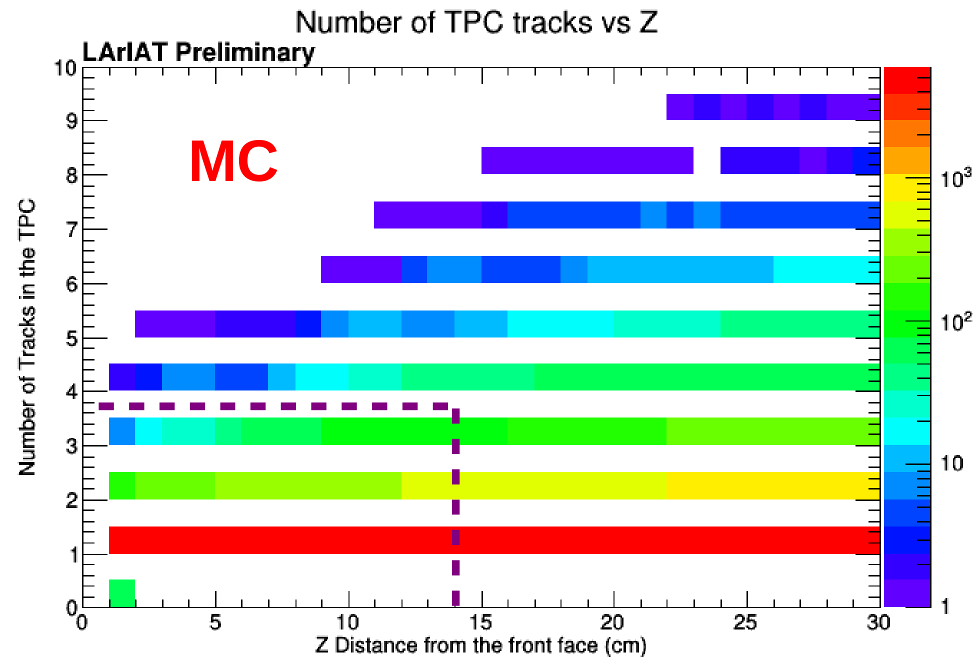


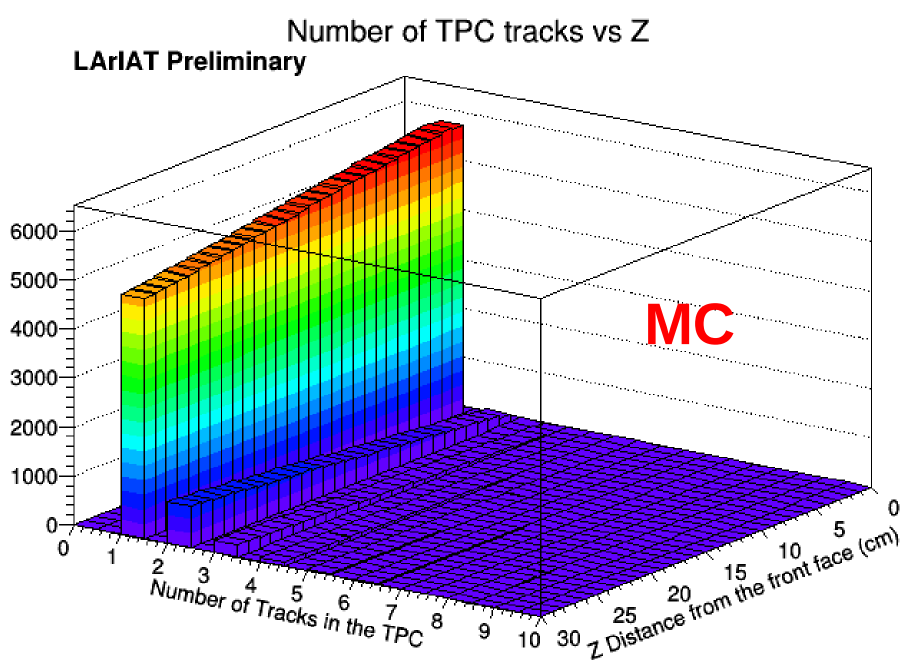


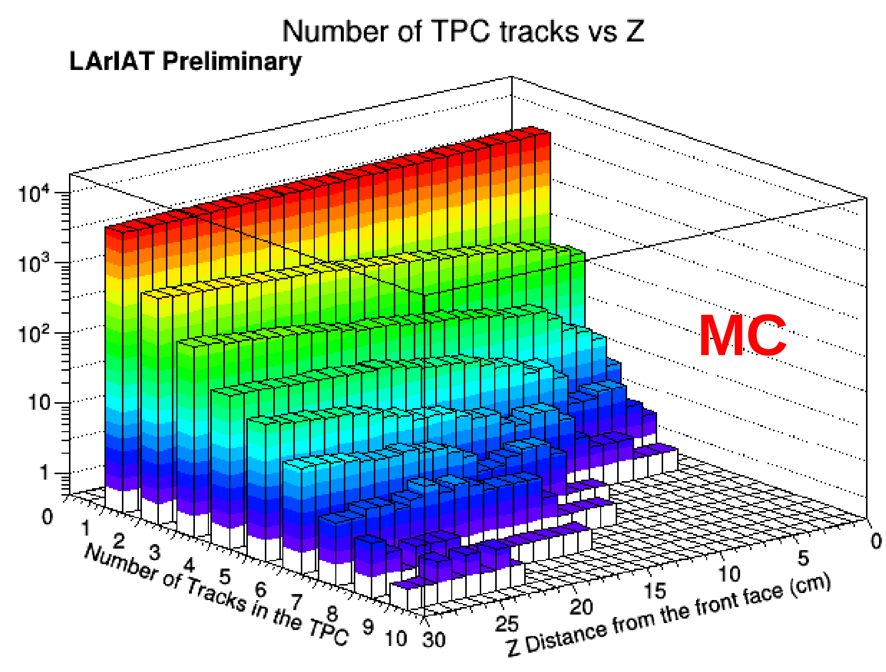
- **Three representations of the same plot**
  - We require that in the first 14 cm there are fewer than 4 tracks in the TPC
    - Fairly insensitive as a function of Z position
    - Could consider extending this cut up to 5-6 tracks to pick up more events (~20% of the final sample)
      - Looking at what the MC has to tell us.....

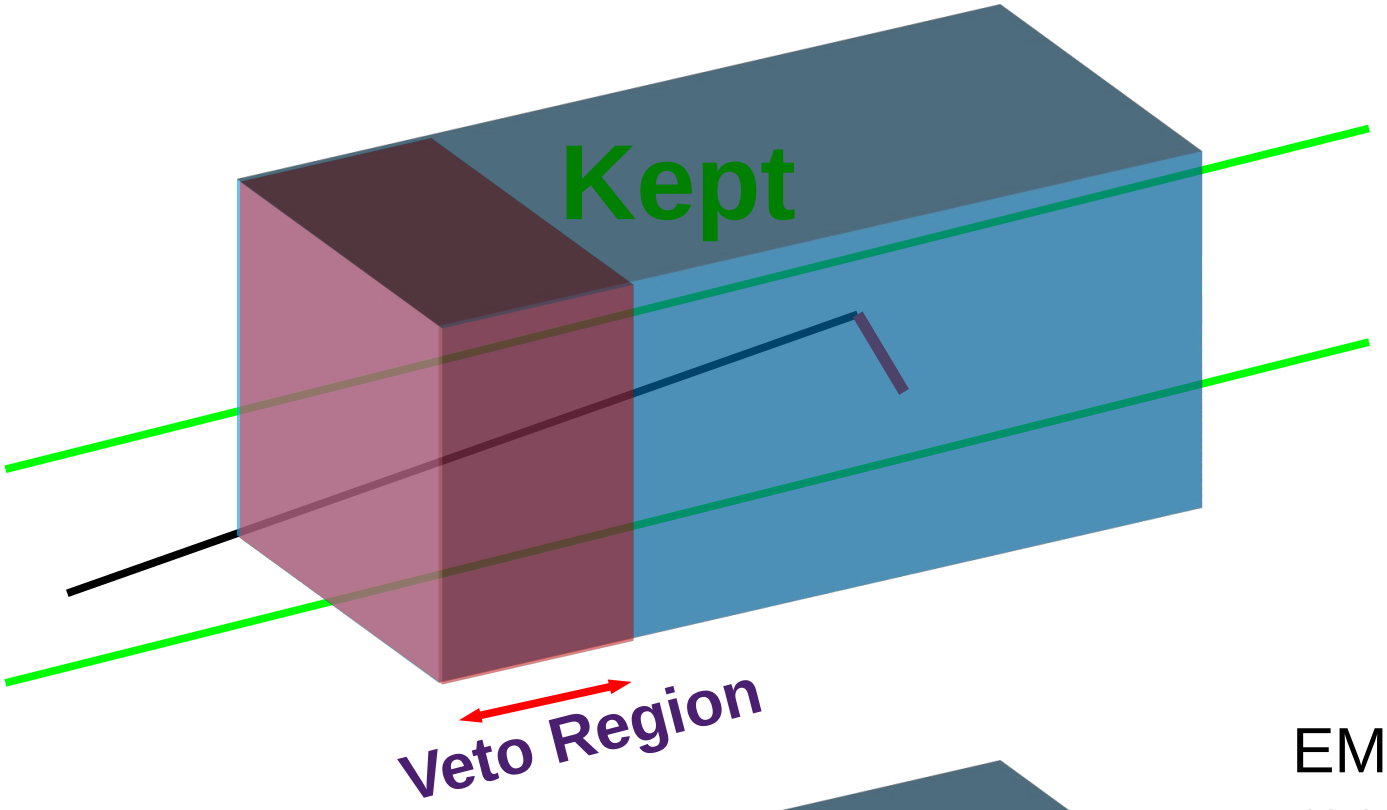
What does MC tell us?

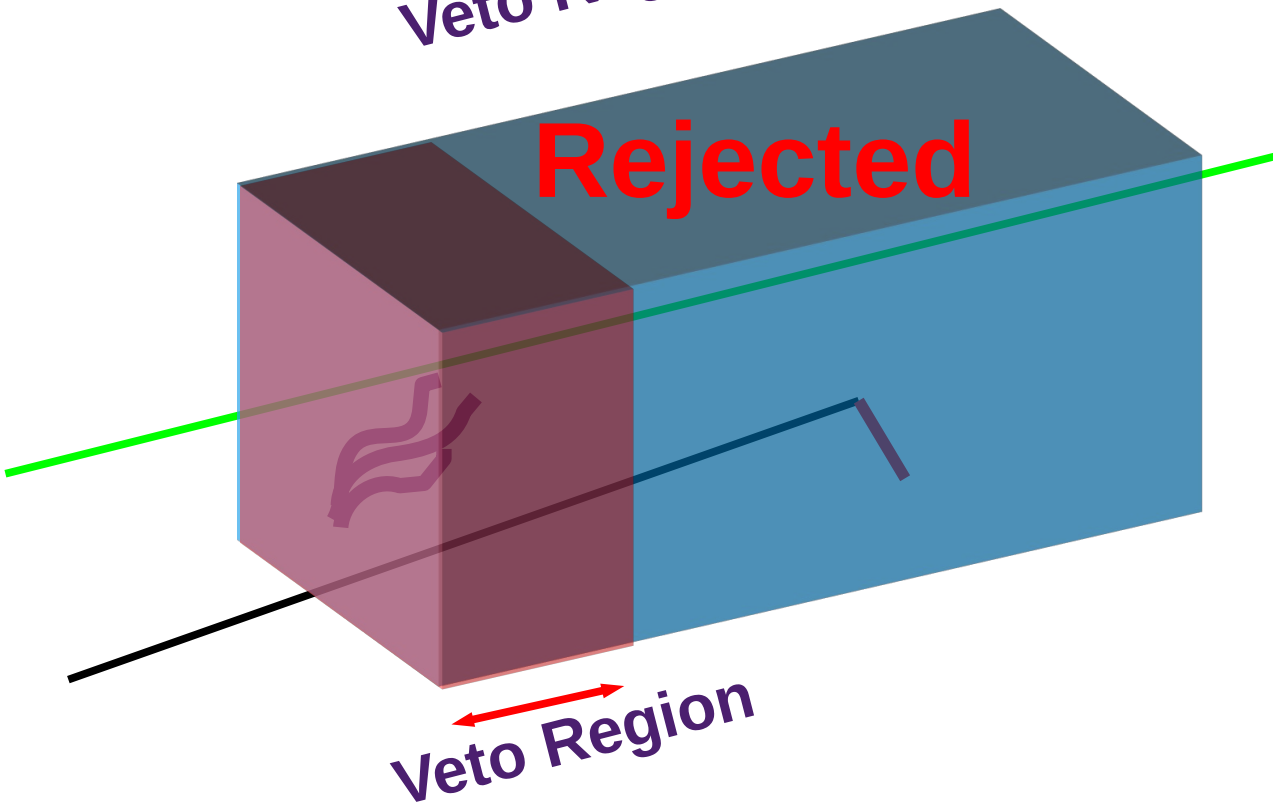








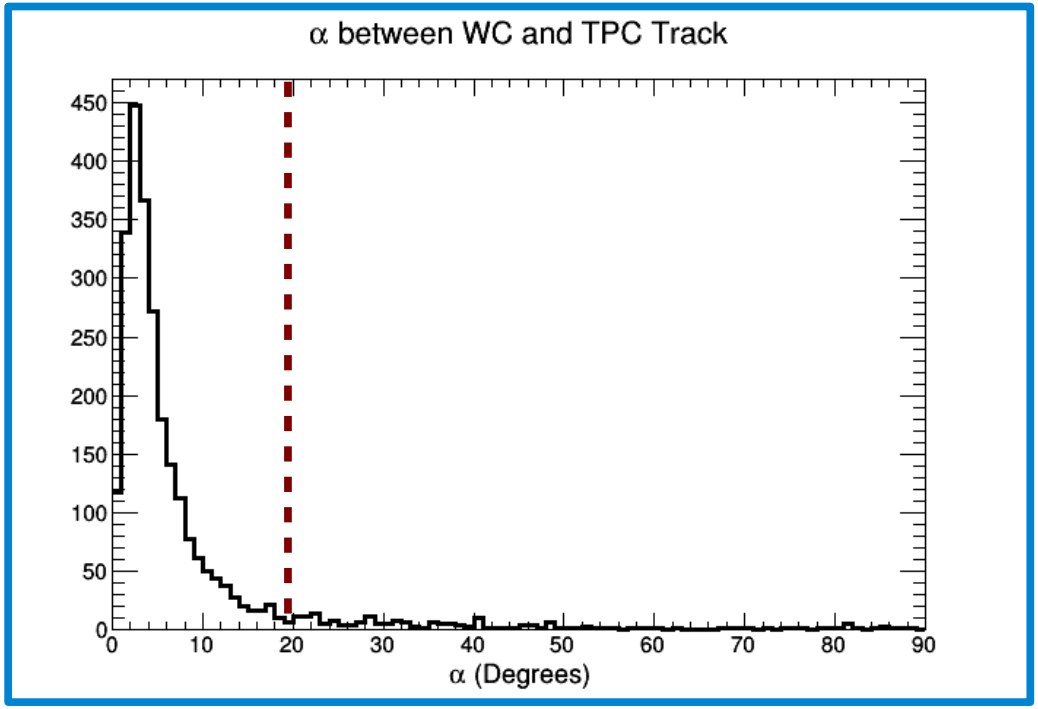




EM Showers are reconstructed as many small tracks....so any EM shower that accompanies a pion will cause the event to fail

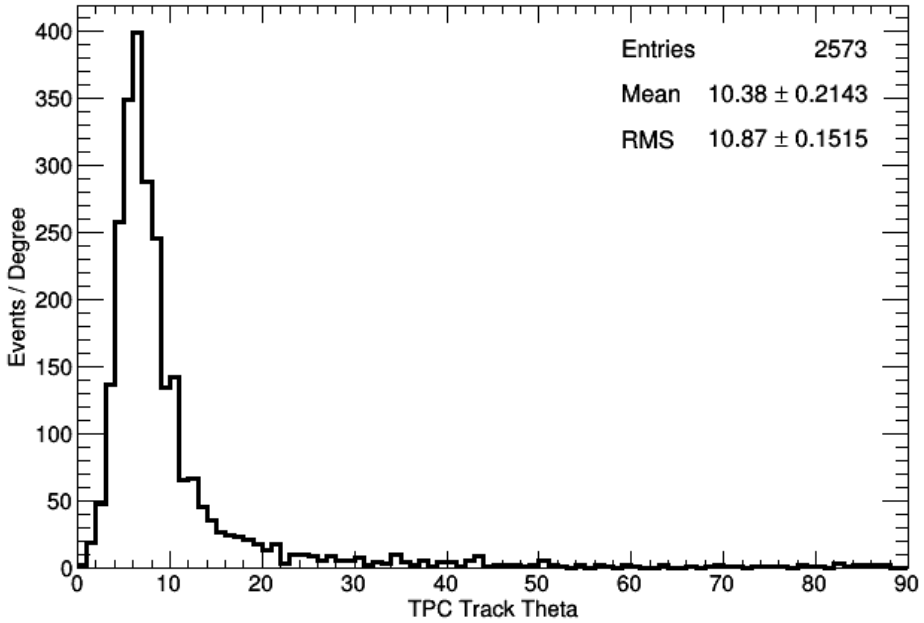
However, this protects us from accidentally counting and EM shower as a pion

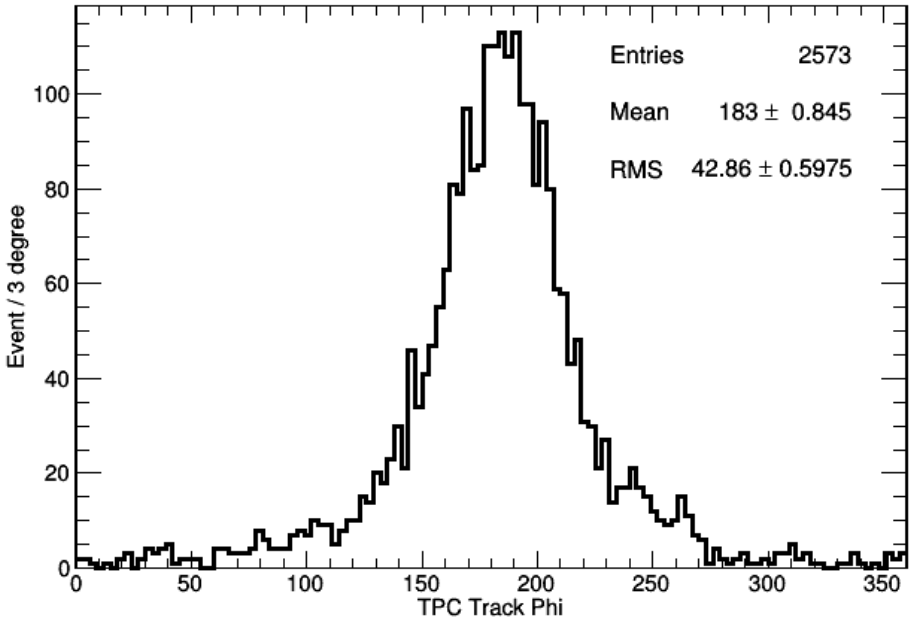
Plots of the cuts

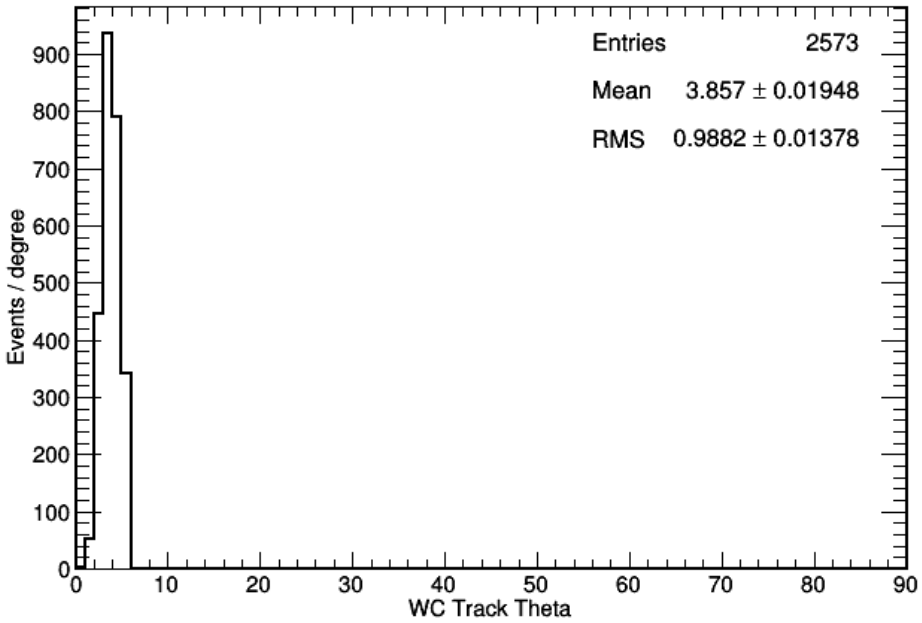


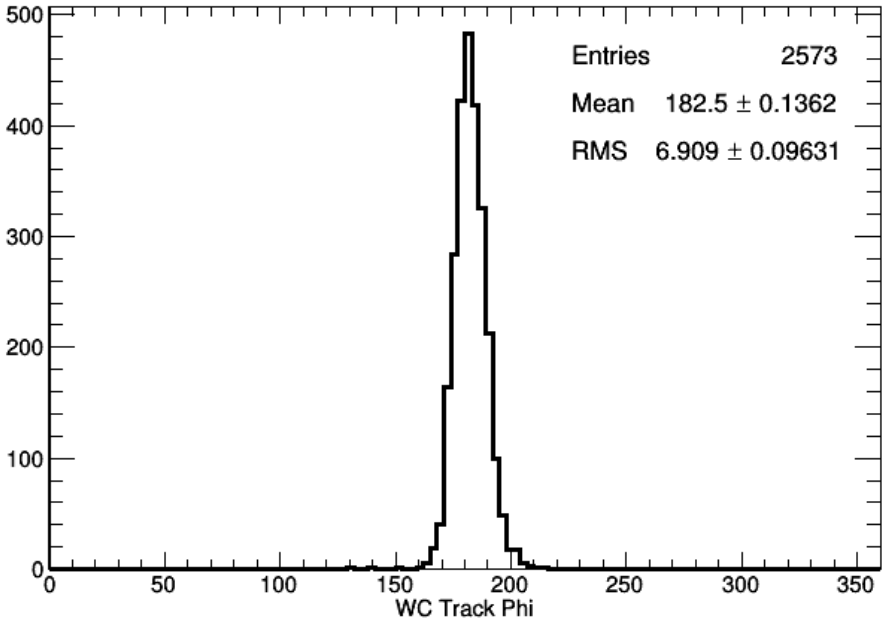
- **This is the angle between the TPC track and the WCTrack**

Plots of the cuts

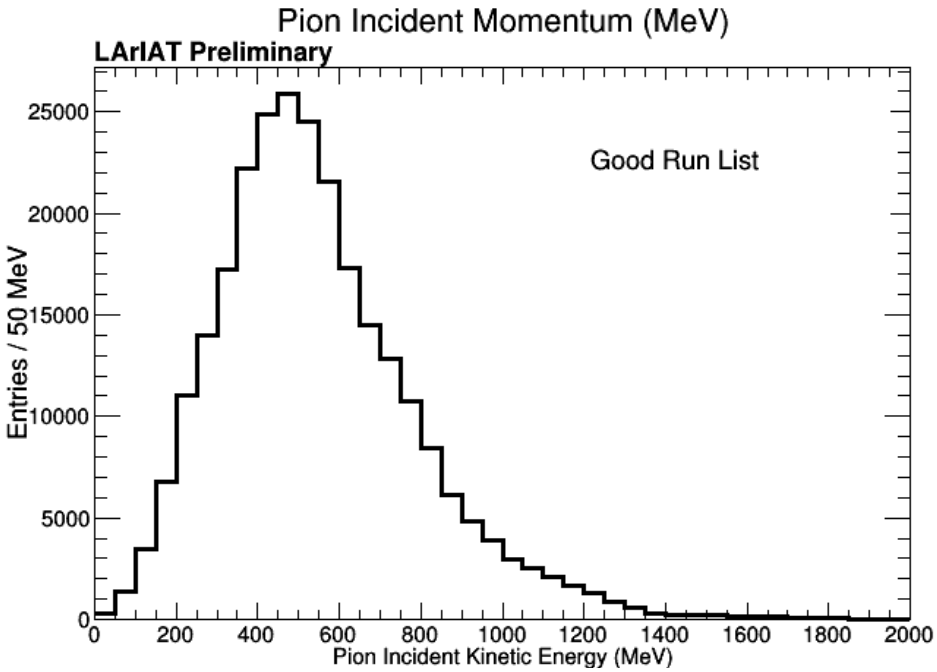


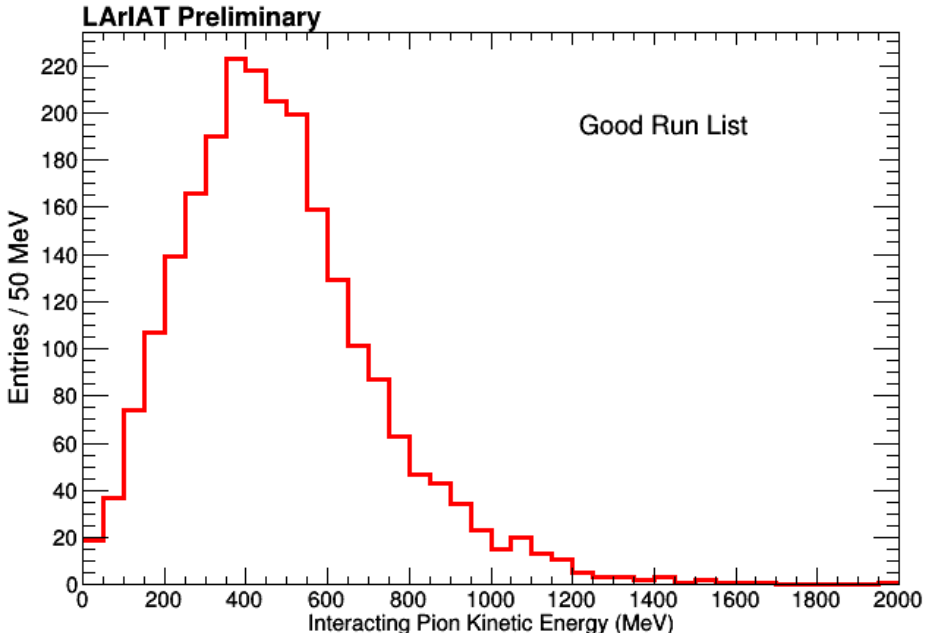


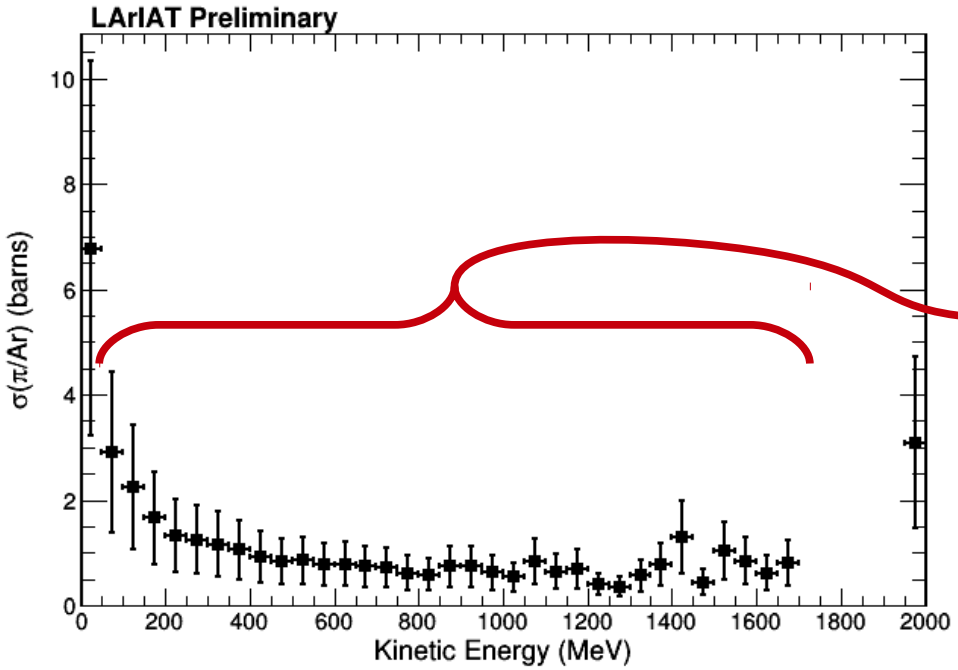


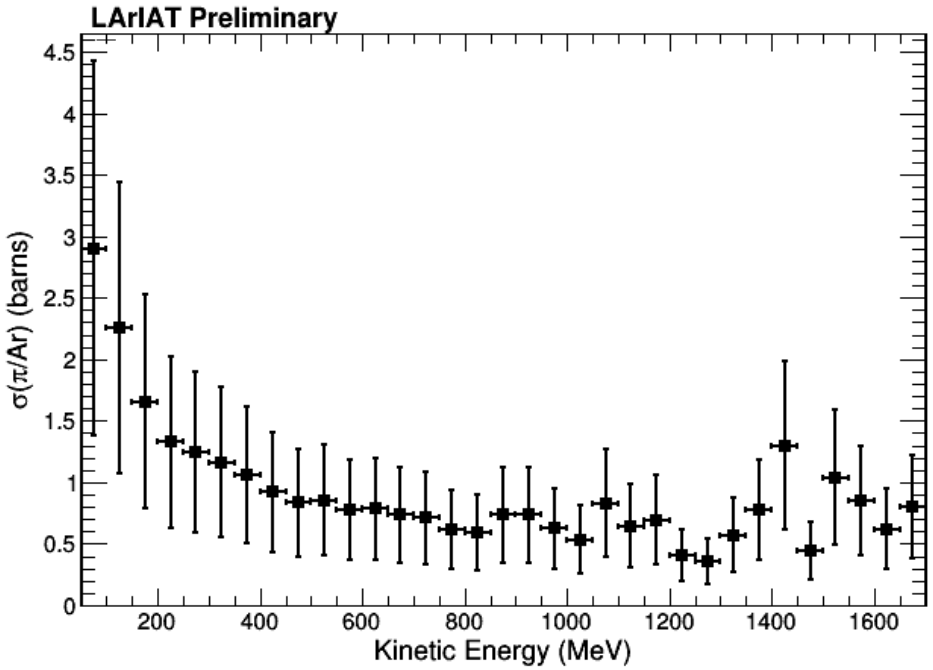


Preliminary Results

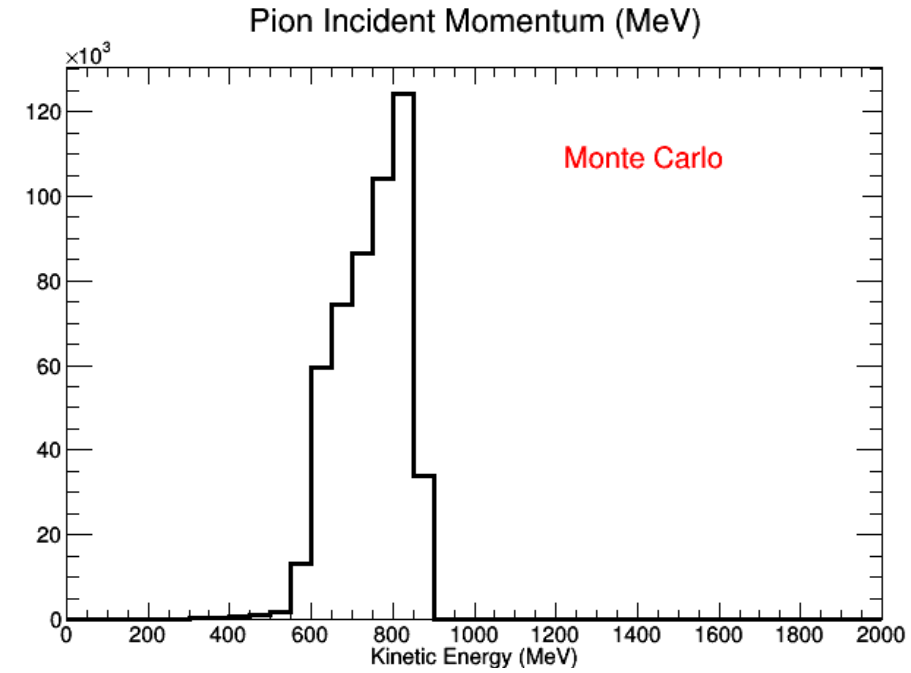


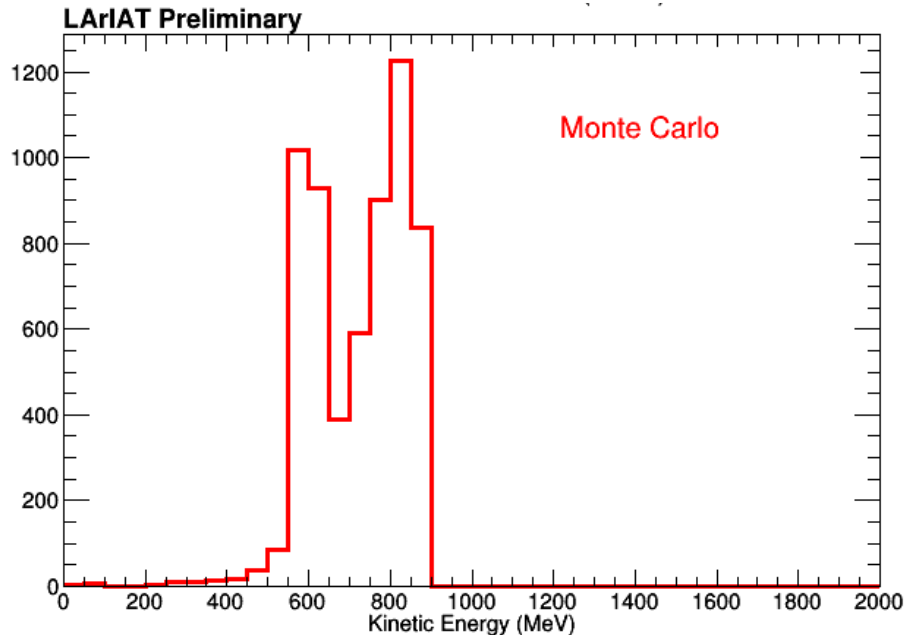


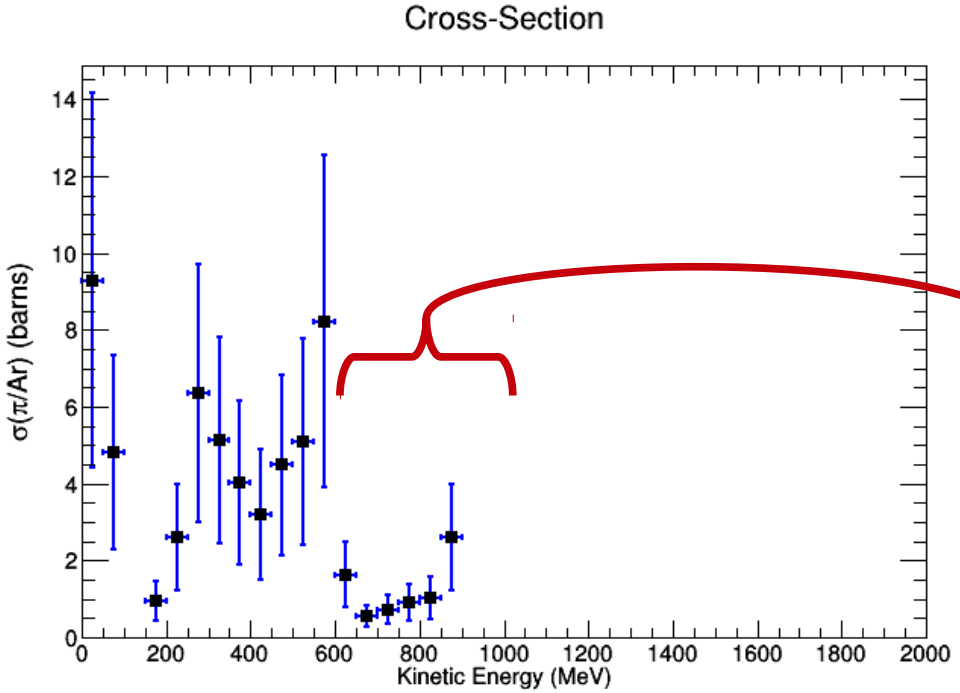


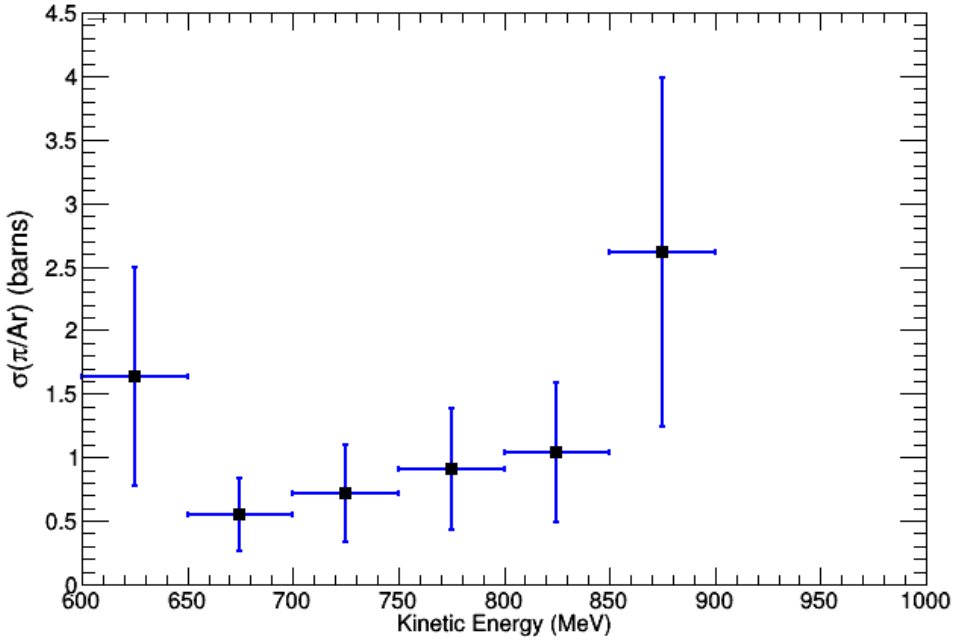


Monte Carlo

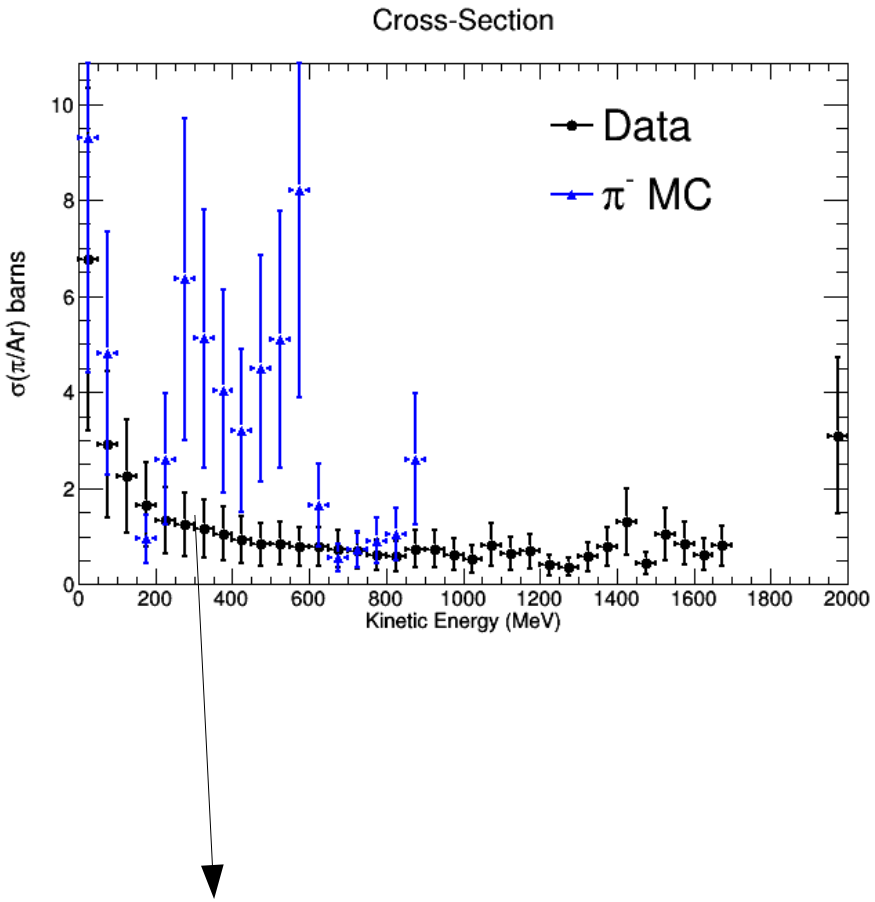

Pion Incident Momentum (MeV)
×10³
Monte Carlo
Kinetic Energy (MeV)

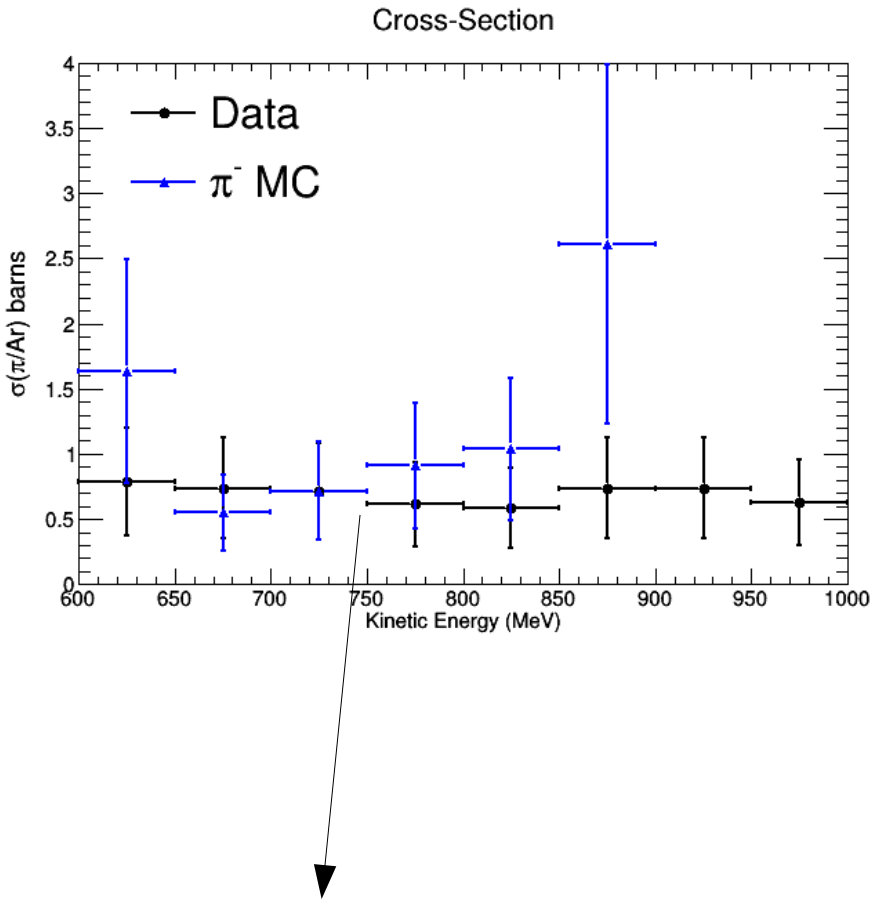

LArIAT Preliminary
Monte Carlo
Kinetic Energy (MeV)


Cross-Section
σ(π/Ar) (barns)
Kinetic Energy (MeV)


Cross-Section
σ(π/Ar) (barns)
Kinetic Energy (MeV)

Data / Monte Carlo

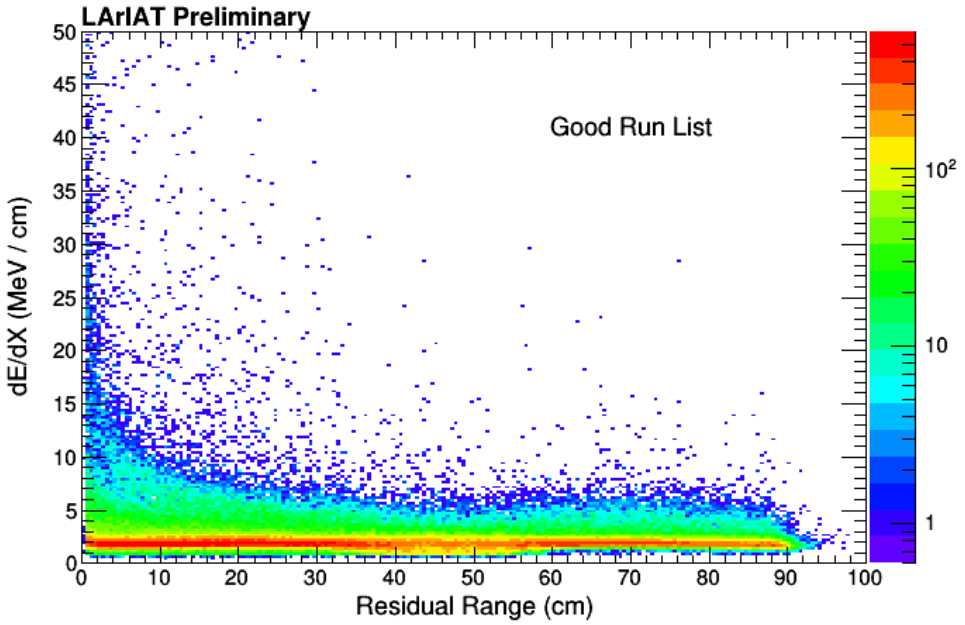


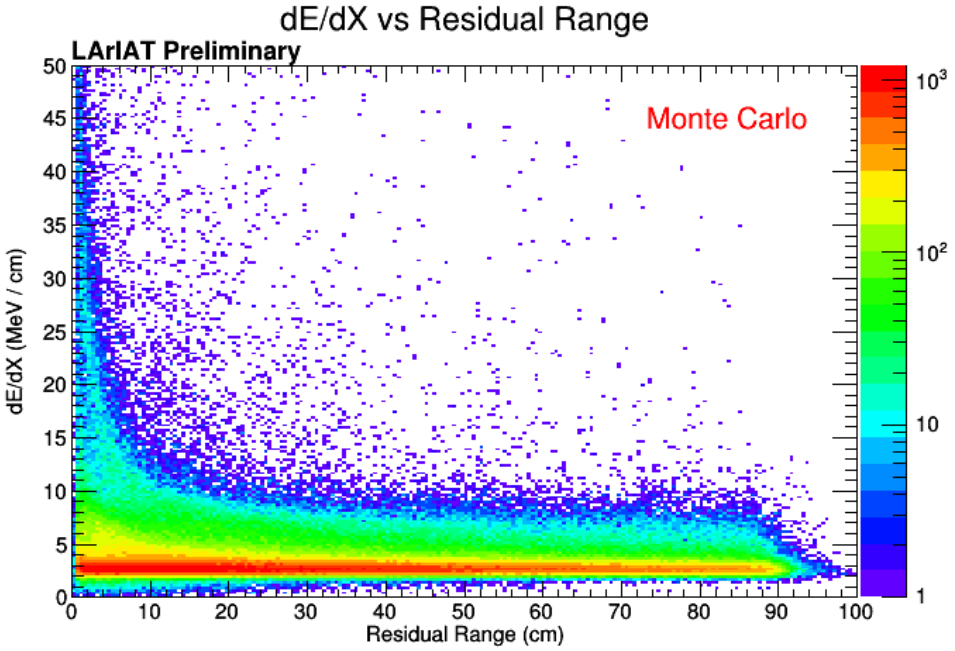


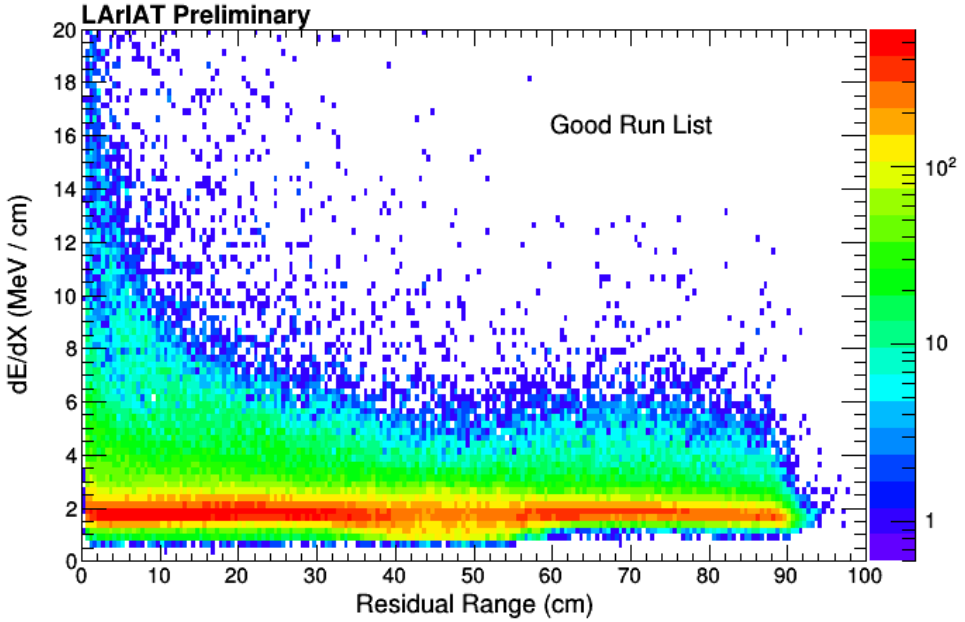
Low statistics in the data

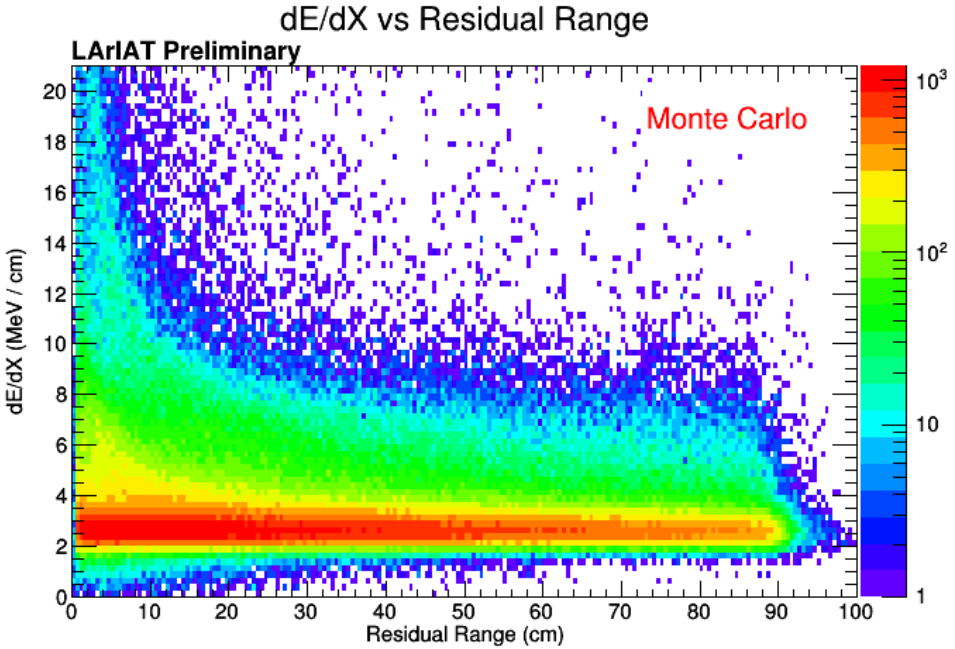
In the higher energy data is within the error of MC

Some plots to think on...









New cuts to consider

- Removing stopping pions
  -
- Others????
  -

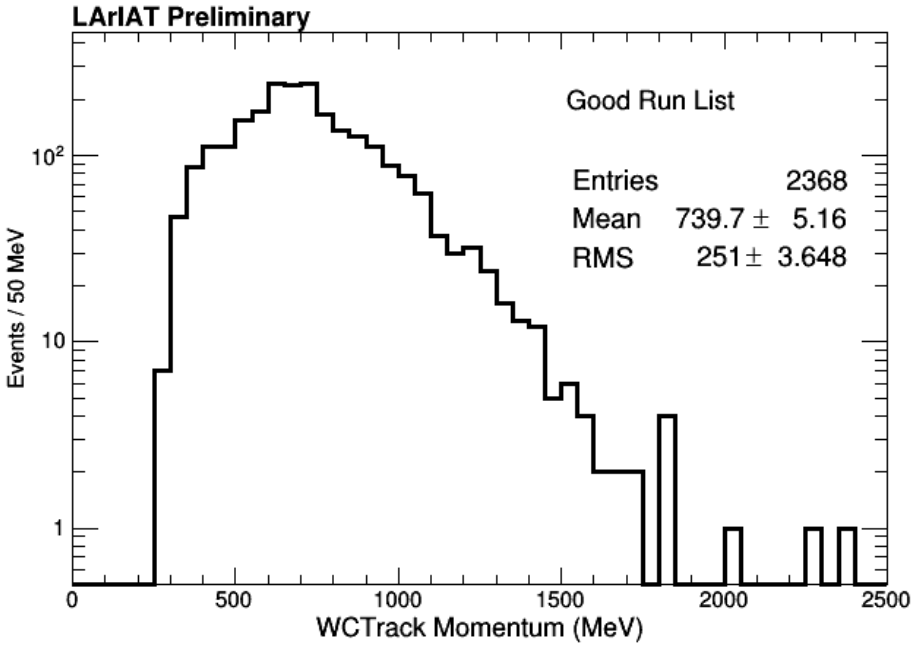
Backup Slides

Monte Carlo Single π^-

- physics.producers.generator.PDG: [-211]
- physics.producers.generator.P0: [0.75] ←***This generated at three points (0.5, 0.75, 1.0 GeV)***
- physics.producers.generator.SigmaP: [0.5]
- physics.producers.generator.X0: [25]
- physics.producers.generator.Y0: [0]
- physics.producers.generator.Z0: [-8]
- physics.producers.generator.T0: [0]
- physics.producers.generator.SigmaX: [10]
- physics.producers.generator.SigmaY: [5]
- physics.producers.generator.SigmaZ: [0]
- physics.producers.generator.SigmaT: [0]
- physics.producers.generator.Theta0XZ: [3.0]
- physics.producers.generator.Theta0YZ: [0.0]
- physics.producers.generator.SigmaThetaXZ: [1.0]
- physics.producers.generator.SigmaThetaYZ: [3.3]

- producers:
  {
  generator: @local::lariat_singlep
  largeant: @local::lariat_largeant
  daq: @local::lariat_simwire
  rns: { module_type: "RandomNumberSaver" }
  }

Some plots to think on...



Where this data lives

- **Sliced Data for individual runs**
  - /pnfs/lariat/scratch/users/jasaadi/Run6***_NewSliced/
- **Beamon / No Pileup combined Runs**
  - /lariat/data/users/jasaadi/NewChargedPionAnalysis_+BEAMON-PILEUP
- **Beamline Reconstructed Files**
  - /lariat/data/users/jasaadi/NewChargedPionAnalysis_+BEAMON-PILEUP_BeamlineReco/
- **Full Reconstruction (Beamline + TPC)**
  - /lariat/data/users/jasaadi/NewChargedPionAnalysis_+BEAMON-PILEUP_FullReco/
- **AnaTree Flat Ntuple**
  - /lariat/data/users/jasaadi/NewChargedPionAnalysis_+BEAMON-PILEUP_AnaTreeFiles

Updates to Offline Analysis

- **Added a cut on the number of tracks in the upstream portion of the TPC**
  - Both the region of interest in the TPC and the number of tracks allowed is configurable
    - Right now I use the first 14 cm of the TPC (radiation length of a photon in argon)
    - I require < 4 tracks in this region
- **I removed the cut which was requiring the track to be stopping inside the TPC**
  - Now I count both stopping and non-stopping tracks into the cross-section analysis
- **I added back the angle cut between the TPC and wire track**
  - Thanks to Animesh, Greg, and Jason for going through the geometry with me to check this result